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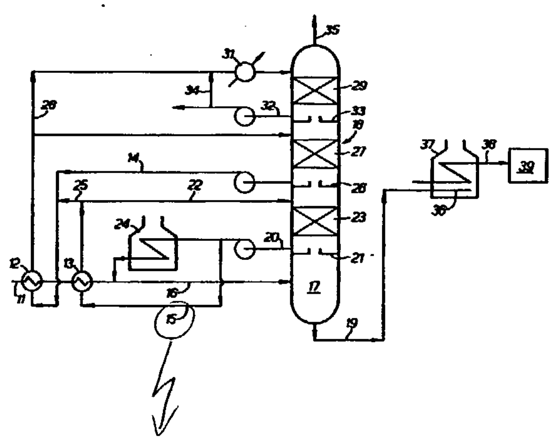
(54) Method and apparatus for the thermal treatment of heavy fuel oil.

(57) A method and apparatus for the thermal treatment of heavy fuel oil. Hot vacuum residue (19) from a vacuum distillation unit (18) is fed directly to burners (36) to raise stream to generate electricity in a generator (39). A gas oil stream (20) is withdrawn from the distillation unit and subjected to mild thermal cracking conditions in a heater (24) which cracks a portion of the waxes which tend to concentrate in the heavier gas oil fractions. The heated stream is mixed with the feedstock inlet stream (16) and so serves to provide the heat energy necessary to operate the distillation unit.



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METHOD AND APPARATUS FOR THE THERMAL TREATMENT OF HEAVY FUEL OIL

The present invention relates to a method and apparatus for the thermal treatment of heavy fuel oil, for example a method and apparatus to recover lighter products and to utilise the heavier products, and such a method comprises supplying the heavy fuel oil to a vacuum distillation unit operating at a sub-atmospheric pressure, withdrawing a heavy gas oil and any other contained lighter fractions as a top product, and withdrawing a vacuum residue as a bottom product.

In modern oil refineries the reduced crude from a crude oil topping still is commonly passed to a unit referred to as a vacuum unit, where, under sub-atmospheric pressure, heavy gas oil is flashed out and separated from the heaviest petroleum fraction, commonly called vacuum residue. When cooled to atmospheric temperatures this residue is a very viscous fluid.

The heavy gas oil is usually recovered for subsequent use as feedstock in cracking processes and is generally accepted as being more valuable than reduced crude.

When it is required to market vacuum residue as a fuel, it is either necessary to blend in lighter more valuable fractions, such as cracked recycle oil or to process it in a process unit such as a visbreaker, or a combination of both so that it may be readily pumped through pipework at ambient tempeature. All these solutions result in further expense.

It is an object of the present invention to utilise

the vacuum residue as a fuel without the expense and waste of incorporating lighter fractions and/or visbreaking the vacuum residue.

According to the invention, there is provided a method for the thermal treatment of heavy fuel oil characterised by supplying the hot vacuum residue directly to a burner and burning the vacuum residue to release heat energy. The heat energy may be used to generate electricity.

The method may be particularly suitable in situations where a power station receives fuel oil, delivered by water or served by a conncecting pipeline from an oil refinery. In such cases, the method according to the invention is preferably carried out on or close to the power station premises and preferably as close to the boilers as is practically possible. The techniques may be allied to other large consumers of heavy oil fuels such as cement manufacturers.

Thus, reduced crude or heavy fuel oil to typical power station specifications may be recieved at the power station and supplied to a vacuum still to separate out those petroleum fractions lighter than vacuum residue. The vacuum residue may ~~then be~~ at a sufficiently high temperature, e.g. between 200 and 375°C such that it readily flows through pipework and can be effectively burnt in the power station boilers.

The separated heavy gas oil and lighter fractions which are recovered may be returned to the originating oil refinery or may be marketed as a more valuable product than the fuel oil feedstock recieved at the power station.

Transportation economies could also be realised since a ship bringing the fuel to the power station could return with the recovered gas oils as ballast.

Once the vacuum residue has been separated, any

subsequent pipework, intermediate storage and burner systems should preferably be provided with appropriate insulation and heat tracing to keep the fuel hot.

Thus, a considerable benefit of the method of the invention is that it is possible to save that energy which would otherwise be consumed in visbreaking the vacuum residue or alternatively to conserve more valuable lower boiling petroleum fractions so that they may be put to more useful applications.

Preferably the method includes the steps of withdrawing one or more fractions from the column and heat-exchanging these streams against the feedstock inlet stream to the column.

A characteristic of many crude oils is that wax components tend to concentrate in the heavier gas oil fractions recovered in a vacuum unit. This impairs the fluid flow characteristics of the recovered heavy gas oil, especially at ambient temperature. A method of measuring this characteristic is a well known test to determine the pour point of the fluid. Pour points greater than 25°C are generally unacceptable. It is quite common for recovered heavy gas oil to have a pour point value greater that 25°C.

It is well known that wax tends to accumulate in the heavier gas oils recovered in vacuum stills and invariably results in pour points greater than 25°C. Clearly, this will be unacceptable when that fraction has to be shipped or transported at ambient temperature.

There are several well established processes for removing these waxes. One example is solvent extraction

though this can be quite expensive. Another process entails subjecting the heavy gas oil to mild thermal cracking conditions which may break down a substantial proportion of the wax.

It is therefore a further object of the present invention to improve the fluid flow characteristics of recovered heavy gas oil and vacuum residue by reducing the wax content.

Preferably, therefore, the heat supplied to the system to enable the vacuum column to operate is also used to subject a portion of the fuel oil, namely the heavier gas oil fraction, to mild thermal cracking conditions. This is preferably carried out by withdrawing a stream of heavy gas oil from near the base of the vacuum column and passing this stream through a heater. This heated stream may then be mixed with the feedstock inlet stream to the column. No additional heat may be required to be introduced into the system.

Thus, there may be provided a process which separates out heavy gas oil and lighter fractions from a reduced crude or heavy fuel feedstock and simultaneously subjects the heavier recovered gas oils to mild thermal cracking conditions to reduce the wax content and as a result reduce the pour point of both the separated gas oil and vacuum residue. This can also result in the formation of some lighter, more valuable distillate products.

Preferably, the vacuum distillation unit operates at a temperature of between about 150 and 375°C e.g. about 345°C and at a pressure of between 0.03 and 0.3 atmospheres e.g. about 0.065 atmospheres.

According to another aspect of the invention there is provided apparatus for the thermal treatment of

heavy fuel oil comprising a vacuum distillation unit, a heater arranged to supply heat to the distillation unit, a burner arranged to receive directly the hot bottom product from the distillation unit and an electrical generator arranged to convert the heat produced by the burner into electricity.

Preferably the distillation unit includes two or more sections of gas/liquid contact medium and a liquid catch tray beneath each section.

The invention may be carried into practice in various ways and one embodiment will now be described by way of example with reference to the accompanying drawings in which the single figure is a schematic diagram of apparatus for thermally treating heavy fuel oil in accordance with the invention.

Reduced crude feedstock enters the process at 11 at ambient temperature and is heat exchanged in heat exchangers 12, 13 against recirculating heavy gas oil in two recycle streams 14, 15 respectively. The feedstock is then passed via a transfer line 16 to the flash zone 17 of a vacuum column 18 which operates between 0.03 and 0.3 atmospheres pressure and at about 345°C.

In the flash zone 17 heavy gas oil and lighter fractions are flashed out of the feedstock as a vapour and pass up the column 18, whilst the vacuum residue also at about 345°C is removed from the bottom of the column via line 19.

The heavier gas oil fractions are withdrawn as a liquid stream 20 by means of a catch tray 21 located immediately above the flash zone 17 having been

condensed by a cooled recirculating gas oil stream 22, in a packing section 23. The heavier fractions are fed to a heater 24 where the temperature is raised to about 480°C to induce mild thermal cracking. This tends to crack and hence reduce the wax components in the gas oil. The heated stream is then mixed with the feedstock in line 16 and thus recycled.

A portion of the withdrawn heavy gas oil 20 is heat exchanged with feedstock as recycle stream 15 in heat exchanger 13, cooled to about 260°C and returned as stream 22 to the column 18 at the top of section 23.

Excess gas oil in this recirculating circuit comprises an overflow line 25 which joins recycle stream 14. This stream comprises recirculating gas oil from a catch tray 26 located beneath a second packing section 27 and is heat exchanged against the feedstock in heat exchanger 12. The stream is then reintroduced to the column 18 above the packing section 27 where gas oil and lighter fractions in the column are condensed.

Excess gas oil and lighter fractions in the recycle stream 14 comprise overflow stream 28 which is passed to a top packing section 29. This stream 28 is cooled against cooling water or air in a heat exchanger 31 to a temperature between about 40 and 60°C. The final product is withdrawn in stream 32 from a catch tray 33 beneath the packing section 29 at about 75°C and some of this stream is mixed with stream 28 via line 34 prior to its being cooled.

In the process described, the lightest fractions

resulting from mild thermal cracking of the heavier gas oil fraction tend to dissolve into the final withdrawn product stream 32 together with any light fractions contained in the feedstock. This also reduces the load on the vacuum inducing equipment.

As an alternative to overflowing excess gas oil from one circuit to the next a portion or all of the excess gas oil in a circuit may be withdrawn as a separate product.

The vacuum in the system may be induced by any suitable means such as vacuum pumps or steam ejectors (not shown) via a top outlet 35.

The vacuum residue in line 19 is removed from the process at the temperature of the flash zone 17 and either passed directly to burners 36 in a power station boilers 37 or to intermediate hot storage (not shown) without heat exchanging against any other stream. The boilers generate steam which is transferred via steam line 38 to electricity generators 39.

Should the intermediate storage or transfer equipment have a temperature restriction then the vacuum residue in line 19 may be heat exchanged and cooled to the practical temperature limit set by the fluid flow properties of the fuel which will be above 150°C.

CLAIMS

1. A method for the thermal treatment of heavy fuel oil which comprises supplying the heavy fuel oil to a vacuum distillation unit (18) operating at a sub-atmospheric pressure, withdrawing a heavy gas oil and any other contained lighter fractions as a top product (32), and withdrawing a vacuum residue as a hot bottom product (19), characterised by supplying the vacuum residue directly to a burner (36), and burning the vacuum residue to release heat energy.

2. A method as claimed in Claim 1 characterised in that it further includes withdrawing a gas oil stream (20) from the distillation unit (18), subjecting this stream to mild thermal cracking conditions (24) in which the temperature of the stream is raised whereby a portion of the waxes present are cracked, and recycling the stream (16) to the distillation unit, the heat supplied being sufficient to cause heavy gas oil and any lighter fractions to flash off in the distillation unit.

3. A method as claimed in Claim 2 characterised in that the heated stream is introduced into the feedstock inlet stream (11).

4. A method as claimed in any of Claims 1 to 3 characterised in that the withdrawn gas oil stream (20) is heated to a temperature of about 450 to 500°C.

5. A method as claimed in any preceding Claim characterised in that one or more streams (14) are withdrawn from the distillation unit and heat-exchanged against the feedstock inlet stream (11) to the distillation unit (18) prior to their being recycled (28) to the distillation unit.

6. A method as claimed in any preceding claim characterised in that the heat energy released is used to generate electricity (39).

7. Apparatus for the thermal treatment of heavy fuel oil comprising a vacuum distillation unit (18) and a heater (24) arranged to supply heat to the distillation unit, characterised by a burner (36) arranged to receive directly the bottom product (19) from the distillation unit.

8. Apparatus as claimed in Claim 7 characterised in that the heater (24) receives a gas oil stream (20) from the distillation unit (18) and heats the stream thereby subjecting the stream to mild thermal cracking conditions, the stream subsequently being reintroduced (16) to the distillation unit with the heat required for its operation.

9. Apparatus as claimed in Claim 7 or Claim 8 characterised in that the distillation unit includes two or more sections of gas/liquid contact medium (23, 27,29) and a liquid catch tray (21,26,33) beneath each section.

10. Apparatus as claimed in any of Claims 7 to 9 characterised in that the burner (36) and the generator (39) comprise parts of a conventional electricity generating station.

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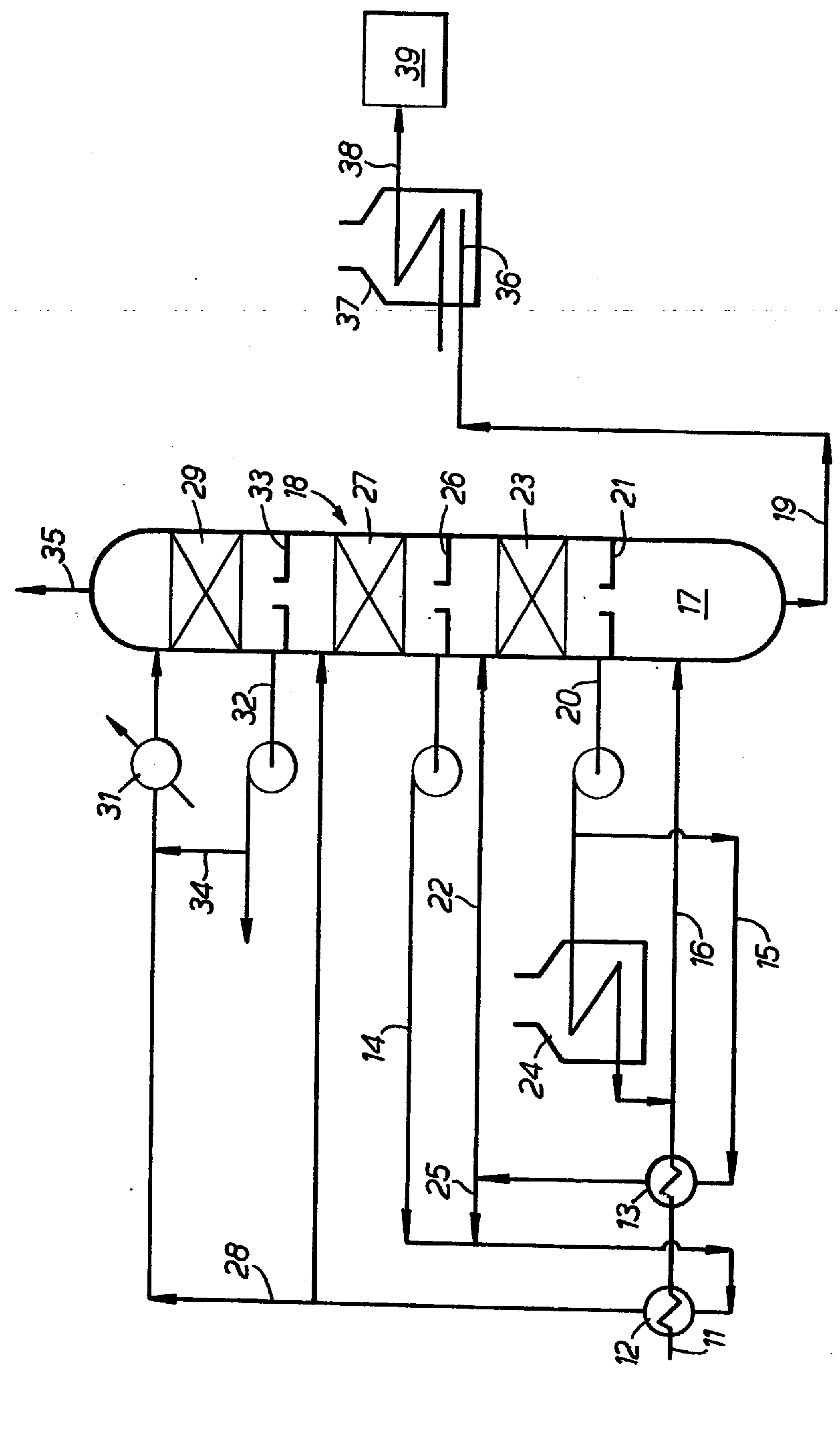
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EUROPEAN SEARCH REPORT

Application number

EP 82 30 2978

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
A	DE-B-1 034 299 (JOSEF RAKY) *Claim 1; column 1, line 1 - line 55* ---	1	C 10 G 7/06
A	GB-A- 829 966 (ESSO RESEARCH AND ENGINEERING COMPANY) *Claims 1-2* ---	1,2	
A	US-A-3 207 675 (RALPH GLADIEUX) *Claims 1-3* ---	1,7	
A	US-A-1 945 600 (GEORGE COUBROUGH) *Claims 1-5; page 3, lines 39-68* ---	9	
A	GB-A- 389 203 (AGUSTE HAECK) *Claims 1-9* -----	9	TECHNICAL FIELDS SEARCHED (Int. Cl. 3): C 10 G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	17-03-1983	PIELKA I.A.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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